



U.S. Department of Energy  
Energy Efficiency and Renewable Energy

# 5<sup>th</sup> Annual CHP Roadmap Workshop

September 20, 2004

Merrill Smith

Office of Distributed Energy

U.S. Department of Energy



# Accomplishments on the Road to 92 GW of CHP

A discussion of accomplishments  
since last year's roadmap meeting

OR

*What have you done for me lately?*



# CHP Vision and Technology Roadmap

By 2010, **double** the amount of CHP capacity in the United States

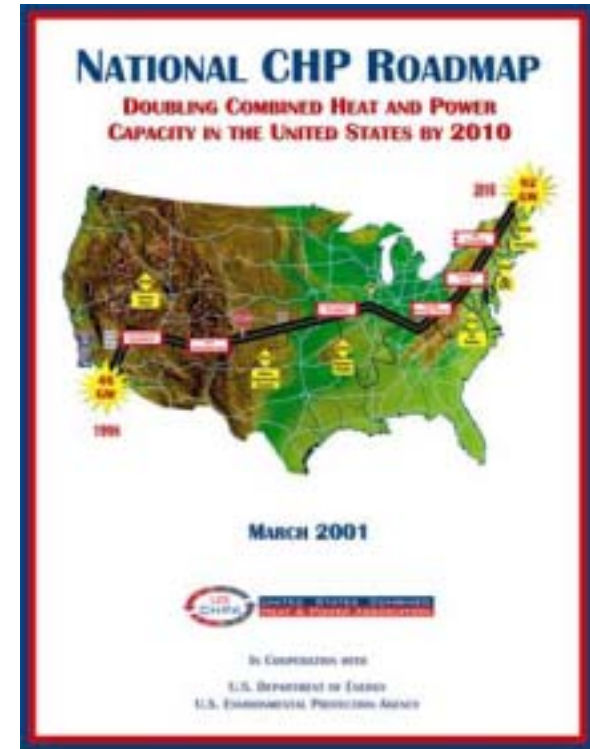
1998, 46GW



2010, 92GW

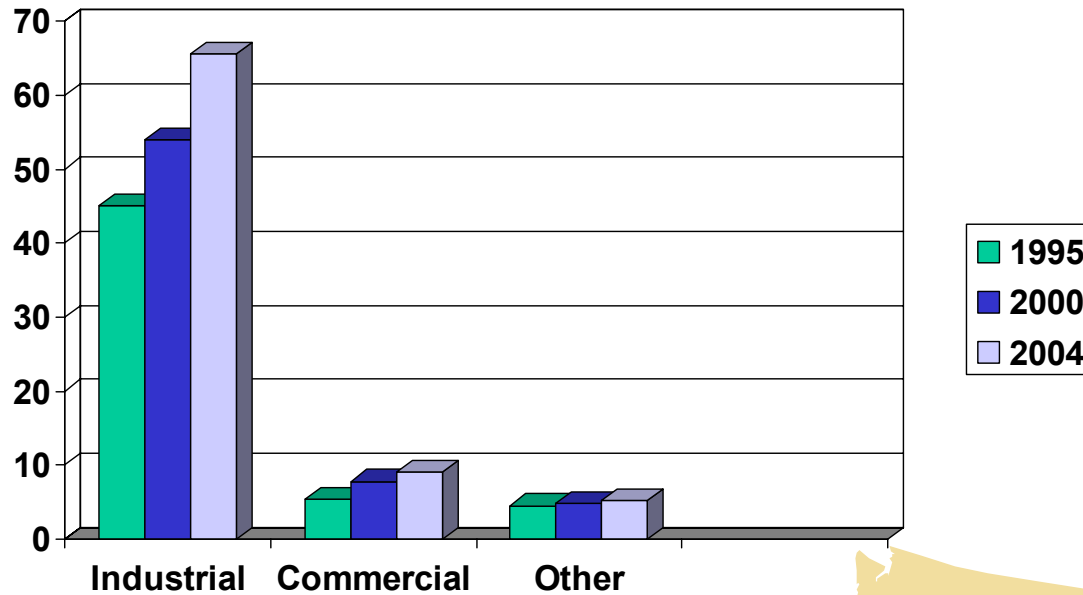
Our CHP activities are guided by the actions identified in the National CHP Roadmap as those items required of us to meet the CHP Goal

- Raise CHP Awareness
- Eliminate Regulatory and Institutional Barriers
- Develop CHP Markets and Technologies





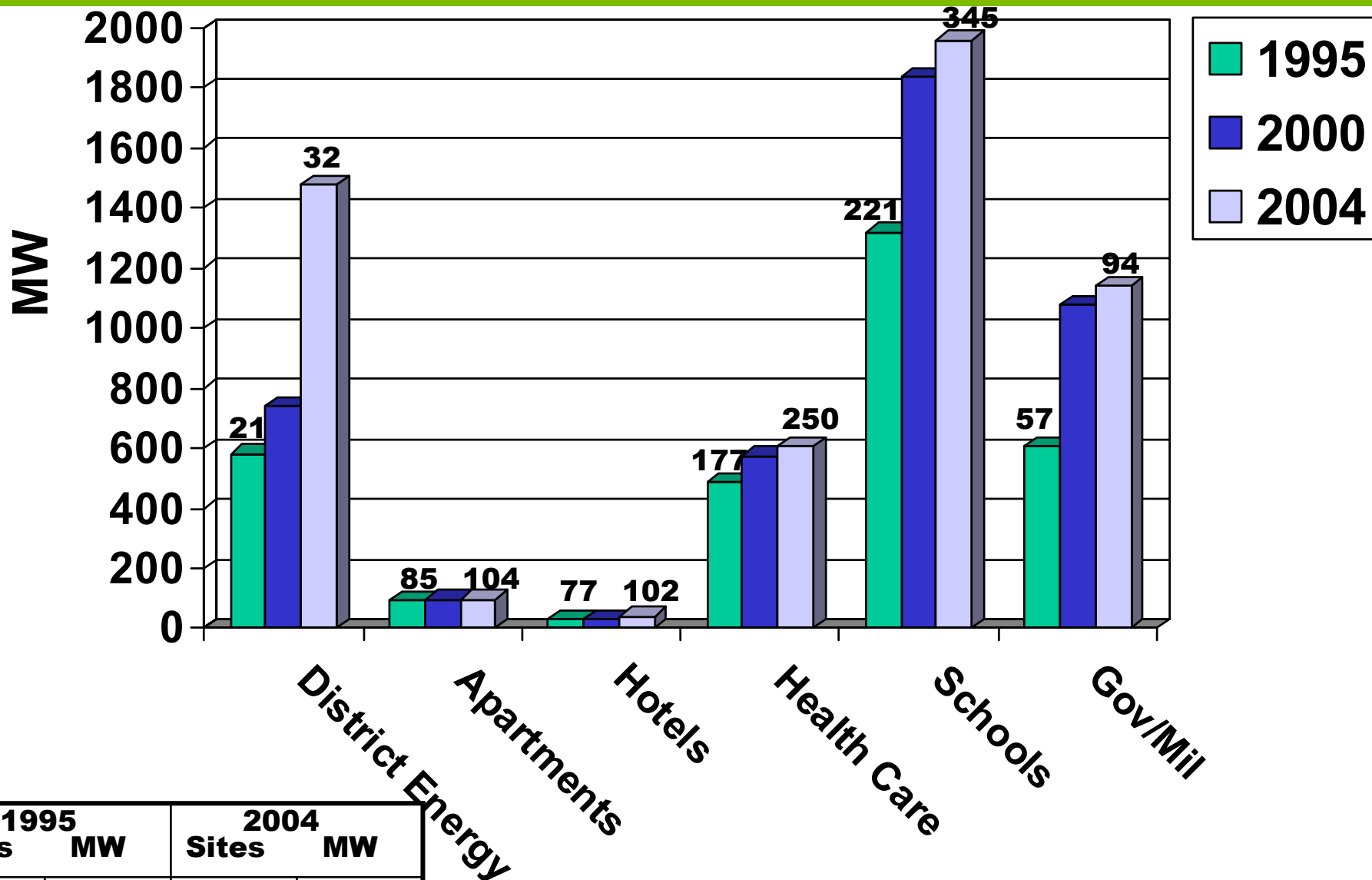
# Where Are We??



Our Progress to Date — September 2004



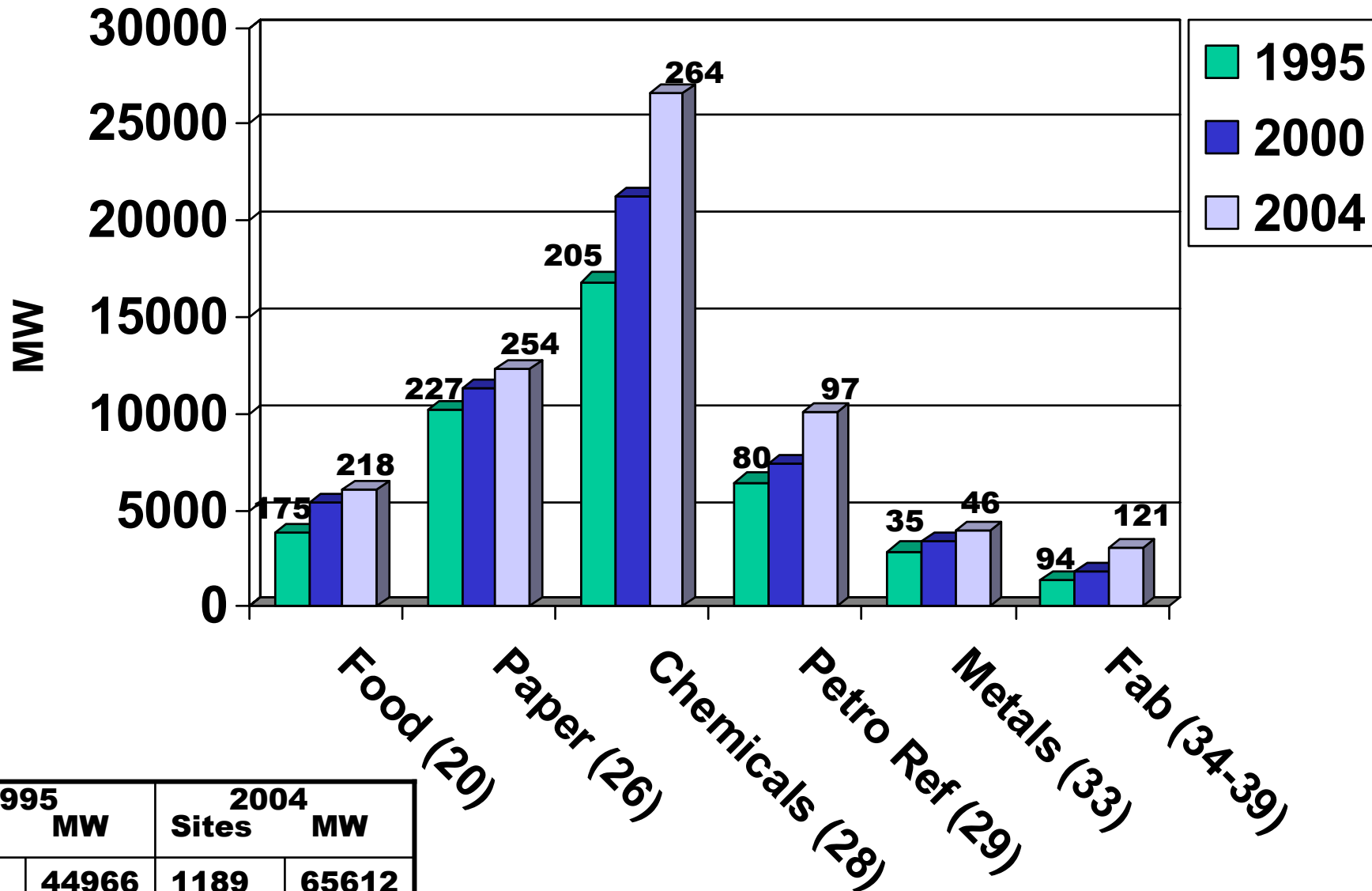
# Commercial



1995		2004	
Sites	MW	Sites	MW
1061	5394	1540	9024



# Industrial



1995		2004	
Sites	MW	Sites	MW
981	44966	1189	65612



# DE Activities Directly Supporting the Advancement of the CHP Goal

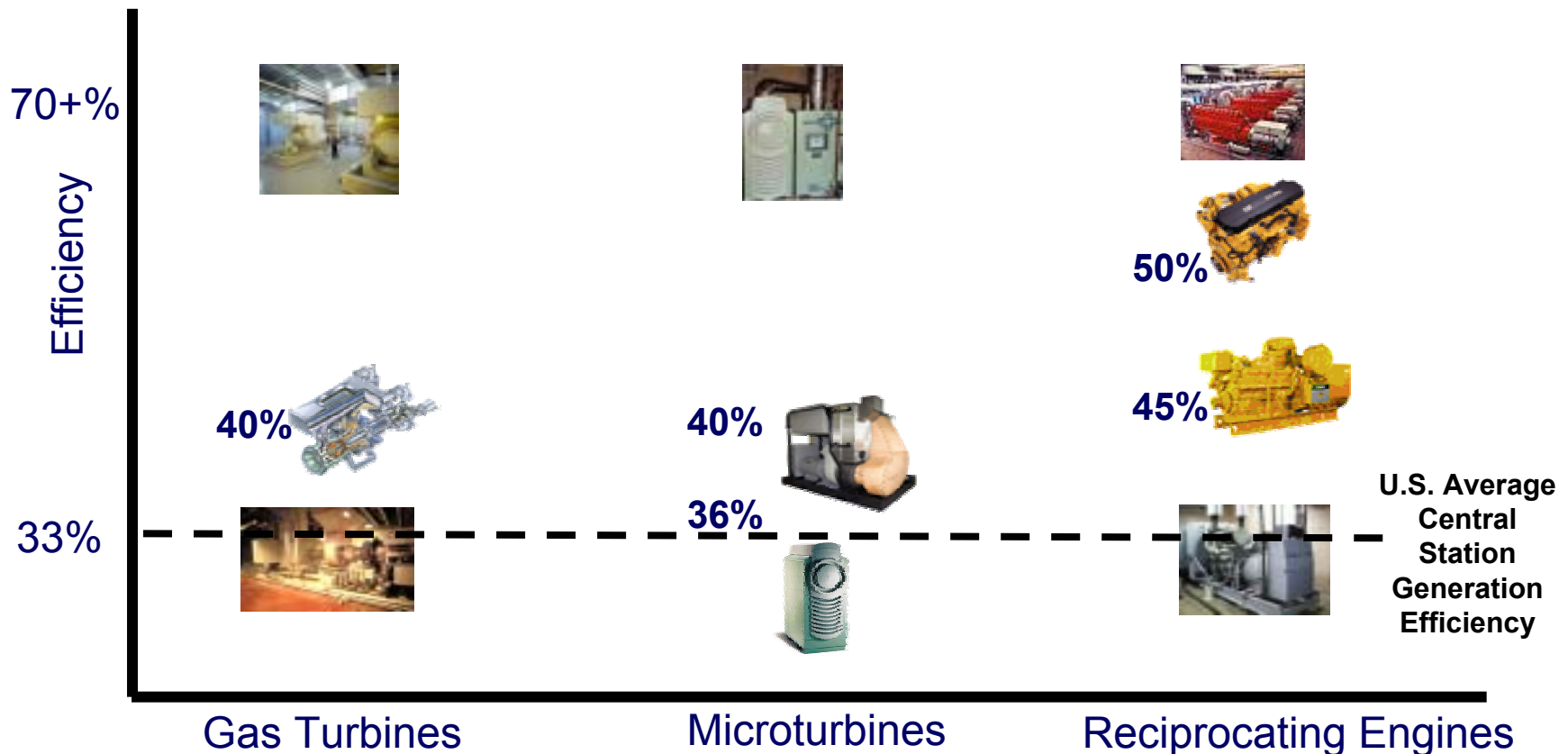
- Improved Generation and Heat Utilization
- Integrated Energy Systems
- End Use Applications
- CHP Outreach and Market Development



# Improved Generation and Heat Utilization and Integrated CHP Systems

By 2008, DER will complete development and testing of a portfolio of distributed generation and thermally activated technologies that will show an average of **25 percent increase in efficiency** (compared to 2000 baseline) with **NO<sub>x</sub> emissions of less than 0.15grams/KWh** at an **equivalent of 10% reduction in cost**.

By 2008, demonstrate the feasibility of **integrated systems in three new customer classes**, which could achieve **70% efficiency** and customer **payback in less than 4 years**, assuming commercial scale production.







# Integrated Energy Systems (IES)

- Integrated Energy Systems
  - combinations of dissimilar subsystems designed or assembled so they work together with higher efficiency and/or lower cost than they would operate individually
- Overcome regulatory, institutional, and market barriers
  - Packaged systems—“plug and play”
  - Modular components factory tested and integrated easing field installation
- Develop model integrated energy systems having 70% efficiency with at least 4 year payback that are easily replicable



# Seven Packaged Systems (IES) Projects Four Up and Running in 2004

- **Honeywell Laboratories – Fort Bragg, NC**
  - 5 MW turbine generator integrated with 1,200 RT waste-heat driven absorption chiller
- **Burns and McDonnell – Austin Energy**
  - 5.2 MW turbine generator integrated with 2,500 RT waste heat fired absorption cooling with greater than 70% efficiency
- **UTRC– Supermarket, New York**
  - Combination of off the shelf components for packaged system—PureComfort™ now commercially available
  - 4, 5, or 6 Capstone 60 Microturbines coupled with 110 to 155 RT Carrier absorption chillers. Also considering refrigeration, desiccants, and thermal storage systems
- **Gas Technology Institute**
  - Engine generator (290 kW to 770 kW) integrated with absorption chillers. Testing underway at GTI.





# Residential Integrated Energy Systems

- Four New Micro CHP projects awarded
  - Heating and Power
    - ECR International – Water based Rankine Cycle, 3kW electric, 40 kW thermal
    - TIAX – 2kW Stirling Engine based system with space heat and hot water
  - Cooling Heating and Power
    - AMTI – 4.7 kW IC Engine, space heat, hot water and thermally activated dessicant system coupled with conventional AC
    - UTRC – Micro CHP equipment assessment and evaluation for optimized residential systems



# Current IES Projects Target Commercial / Institutional Market Sectors



---

200 Market St.  
Austin Energy

---

Butler Hospital\*

Eastern Maine\*

Metropolitan Hospital\*

United Nursing Home\*

---

Ramapo College\*

University of Maryland

Gas Technology Institute

---

Pepperell High School\*

---

Ft. Bragg

---

Cinemark

---

Quality Inn

Hilton

Ritz Carlton\*

Sheraton\*

W. Hotel – NYC\*

---

Raley's \*

HEB

A&P

Ingersol Rand

---

Verizon

---

\*FY04 Solicitation

---



# Healthcare Sector

## **Butler Hospital** (Providence, RI)

UTC Pure Comfort System ( 4 – C60 microturbines) with 110-ton absorption chiller  
Partners: UTC Power, Carrier Corporation, Witham & Associates, New England Gas, CDH Energy



## **Eastern Maine Medical Center** (Bangor, ME)

Gas Turbine (4.4 MW) to generate 24,000 lb/hr of steam and drive a 500-ton absorption chiller.  
Partners: Solar Turbines, Cianbro Corp., Vanderweil Engineers, Univ. of Maine, IDEA



## **Metropolitan Hospital** (Grand Rapids, MI)

Novi Energy  
Reciprocating engines (2 MW) with an absorption chiller.  
Partners: Inland Detroit Diesel, GE Jenbacher, Honeywell, Stanley Consultants, Workstage, and NTH Consultants.



## **Nursing Home** (Bronx, NY)

Real Energy  
Reciprocating engines with absorption chillers  
Partners are Enercon Engineering, Encorp, and USCHPA





# Educational Facilities

## **Ramapo College** (Mahwah, NJ)

GTI

Reciprocating engines (1.6 MW) to generate steam and operate an absorption chiller.

Partners: Preventive Maintenance Services, CDH Energy Corp., Public Service Electric and Gas, Attainment Technologies, Monsen Engineering, Ramapo College of New Jersey



## **Pepperell High School** (Floyd County, GA)

SEMCO

Reciprocating engine (200 kW) coupled with four, classroom, integrated active desiccant HVAC systems

Partners: C&M Engineering, Floyd County Schools, and Hess Microgen





# Hotels and Supermarkets

## **Ritz Carton Hotel**, San Francisco, CA

GTI

UTC Pure Comfort System (4 C-60 microturbines) and 110 ton absorption chiller.

Partners: UTC Power, Pacific Gas & Electric, Carrier Commercial Systems

## **The W Hotel** (Union Square Park, NY)

Real Energy

Reciprocating engines with absorption chillers

Partners are Enercon Engineering, Encorp, and USCHPA

## **Sheraton Hotel Complex** (Rancho Mirage, CA)

Energy Concepts Company

Reciprocating engine (200 kW) + a microturbine (250 kW) and absorption chillers.

Partners: Shenandoah Springs Village, Desert Power Partners, and Ingersoll-Rand.

## **Raley's Supermarket** (Loomis, CA)

TIAX LLC

Reciprocating engine (280 kW) with absorption cooling

Partners are Hess Microgen





# Utilities

**Basin Electric** (Flasher, ND)

Gas Technology Institute  
Pipeline Compressor  
station

Gas Turbine with an  
Organic Rankine Cycle

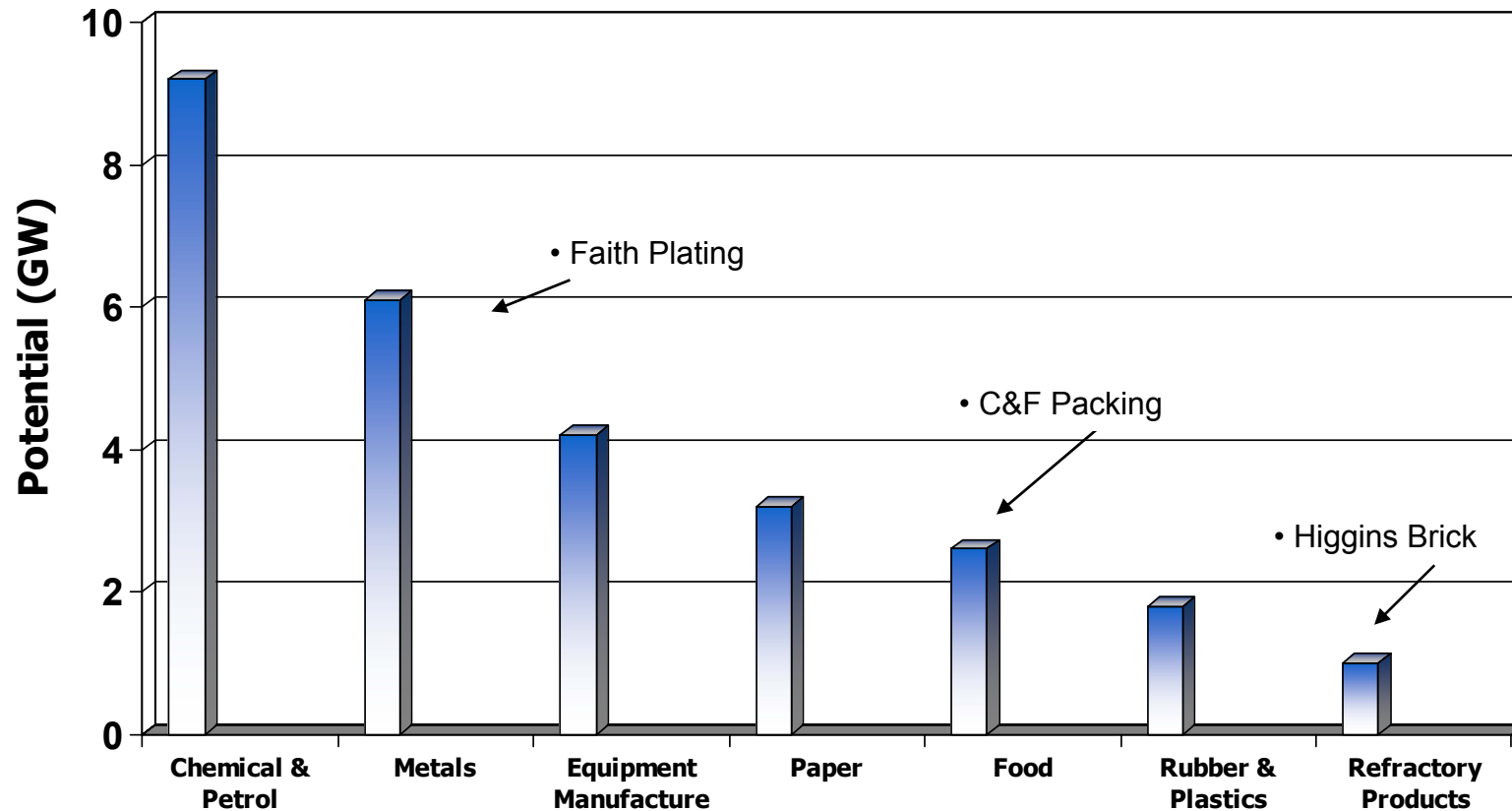
Provides power quality  
improvements to local  
hospital in remote  
location







# End Use Systems Integration - Current Projects Targeting Industrial Sector

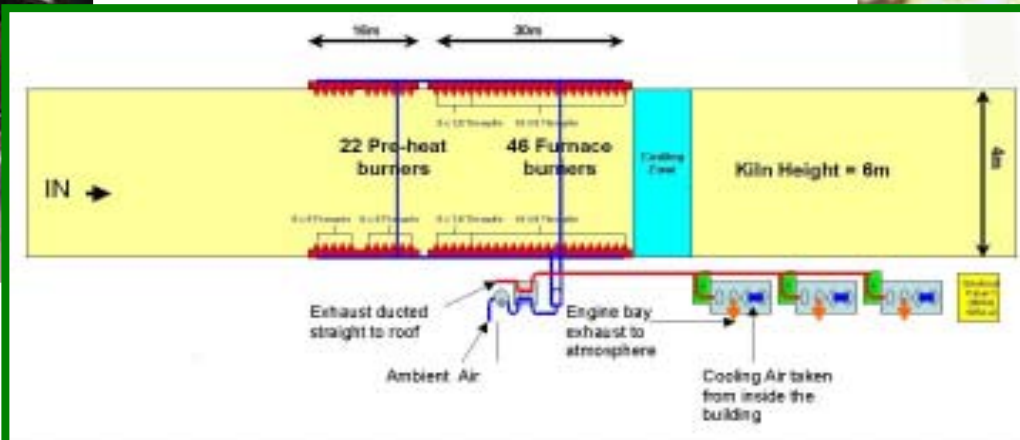


Data from Resource Dynamics, May 2002, *Draft Cooling, Heating and Power for Industry: A Market Assessment*



# Higgins Brick Factory Chino Hills, CA

- Cons. Utility:** SoCal Gas
- Power Gen.:** Three 80 kW Bowman micro-turbines
- Heat Rec.:** Indirect heat exchange to pre-heat kiln comb. air
- Operation:** Three base loaded turbines 24/7
- Status:** Micro-turbines shipped; Installation in progress
- Comments:** Demonstrates waste heat recovery for process heating. Operation scheduled to begin in Summer 04  
Simmax Energy is planning to provide energy services to the plant





# CHP Outreach and Market Development Activities

- Raising CHP Awareness
  - Regional Initiatives and CHP Application Centers (SEP)
  - Annual CHP Roadmap Meeting and Policy Day
  - Participation in trade shows, meetings and educational activities for targeted audiences
- Eliminating Regulatory and Institutional Barriers
  - Air regulations, environmental permitting
    - Research on emissions permitting, Environmental permitting screening tool, Review of environmental models, Develop Regulatory Requirements Database for Electric Generators
  - Interconnection requirements
    - Utility interconnection practices
  - Site permitting, tax treatment
    - Analyze cost and financing of DG/CHP, Review of DG siting procedures
  - Costly standby and backup power charges
    - Electric rate primer, Review of States' CHP activities
- Developing Markets (Targeted Markets Identified)
  - Baseline CHP installations
  - Assess technical and economic potential
  - Identify the value proposition



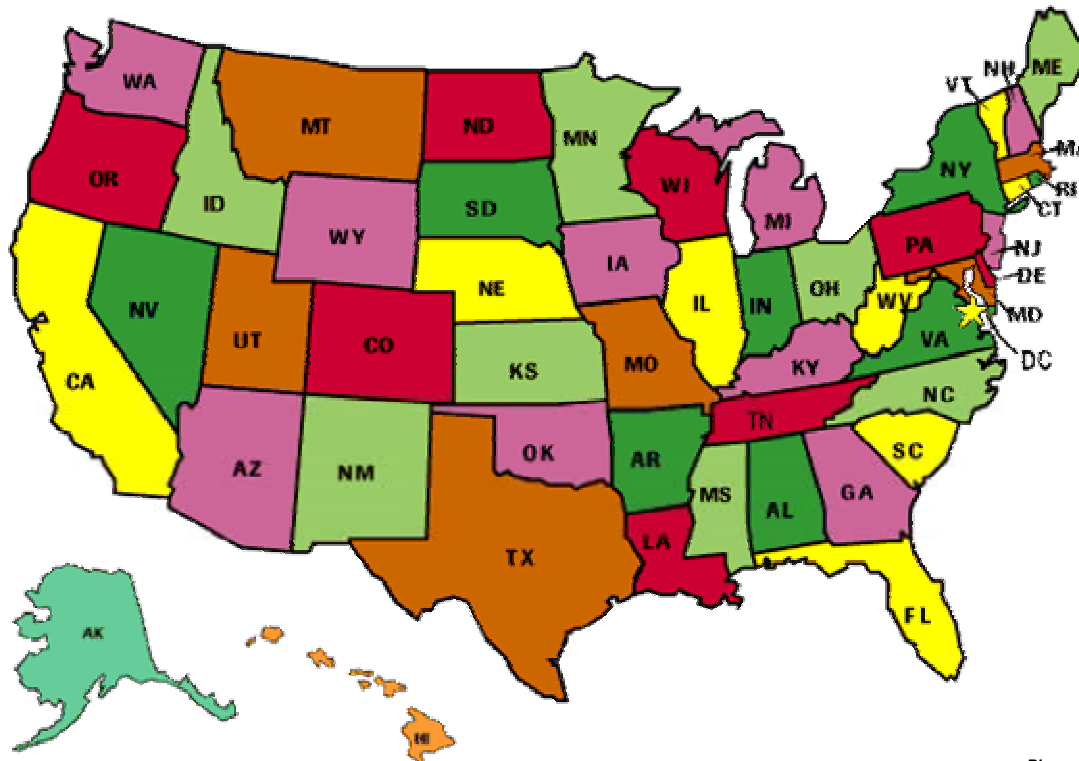
# CHP Outreach and Market Development Activities

- Major accomplishment:
  - 18 projects awarded in 2003
  - Completed analysis to verify 77 GW installed CHP capacity
  - Awarded 5 new CHP Regional Application Centers (FY03)
  - Completed Utility Survey – state legislation, environmental office and public utility commission regulations that apply to CHP (FY03)
  - Completed CHP Installation Database – measures existing GW, tracks progress of specific technology programs and markets, impact of CHP on specific regions and deployment trends (FY03)
- Additional milestones:
  - CHP Database for economically potential CHP facilities in the industrial sector (FY04)
  - Collect and summarize opportunity fuels information for CHP systems – types, quality characteristics and available opportunity of fuel sources and technologies and applications that might benefit/utilize (FY04)
  - Develop simple CHP economic screening tool (FY04)
  - Complete regulatory database (FY06)



# Regulatory Requirements Database for Electric Generators

Click on any state to access state specific information on DG  
permitting issues,  
or click on the state name in the drop box below:



Please Note: The

information for this database was obtained through a combination of interviews with state permitting officials and review of state permitting regulations. This database is a work in progress. Please check back frequently for updates. This work is being done for the U.S. Department of Energy and Oak Ridge National Laboratory. While the information is believed to be accurate, always verify information with appropriate regulatory agencies. This site is best viewed with Microsoft's Internet Explorer 6.0

Specific Issues:

[EMISSIONS  
REGULATIONS](#)

[STATE  
ENVIRONMENTAL  
REGULATIONS](#)

[SITING REGULATIONS](#)

[EXIT FEES](#)

[STANDBY RATES](#)

[BUILDING, ZONING,  
AND FIRE CODES](#)

[AMMONIA ISSUES](#)

[REPORTING  
REQUIREMENTS](#)

[ECONOMIC INCENTIVES](#)

<http://www.eea-inc.com/rrdb/DGRegProject/index.html>



Go Links >>



# TEXAS

[Air Emission Regulations](#) | [Siting Regulations](#) | [Exit Fees](#) | [Regulatory Codes](#) | [Standby Rates](#) | [Incentives](#)

### AIR EMISSIONS REGULATIONS:

### Air Quality Status

### EPA's Nonattainment Areas

### Major Source Threshold

PTE 250 tons of any criteria pollutant in attainment areas, 25 tons in severe, 50 tons in serious and 100 tons in moderate areas.

### Minor Source Permitting Exemption

None. See permits by rule.

### Minor Source Treatment

Standard permit or permit to construct. Requirements below.

### Emergency Generating Limits

Permit by rule.

**DE MINIMIS EXEMPTIONS:**

Permits by rule are issued instead of exemptions. Each permit by rule has a specific set of requirements that a unit must meet. There are over 100 types of permit by rule, however no unit can qualify for a permit by rule if it exceeds 25 tons per year of SO<sub>2</sub> and PM or 250 tons per year of NO<sub>x</sub>, VOCs and CO. If the unit meets all requirements in a permit by rule it registers with the state, but it does not receive a permit. In the registration process sources must show that they will meet all applicable requirements of the permit by rule. The permit by rule that applies to small boilers applies to units up to 40 MMBtu/hr. If the unit is greater than 10 MMBtu/hr it must meet a 0.1 lb/MMBtu NO<sub>x</sub> emission rate. There was a permit by rule for IC engines and turbines, but it is being phased out so these units will all be permitted by the Standard Permit discussed below. The state also has specific limits (such as fuel sulfur and opacity) for each criteria pollutant that automatically apply to all unit's in the state (regardless of permitting requirements). These limits are so high that they are not an issue for modern technologies.

**MINOR SOURCE PERMITTING:**

<http://www.eea-inc.com/rpdb/DGReqProject/AirRegs.html>

Internet

Start Merrill Smith - In... Microsoft Word C:\Documents a... 3 Microsoft Po... EEA Database ... 10:51 AM





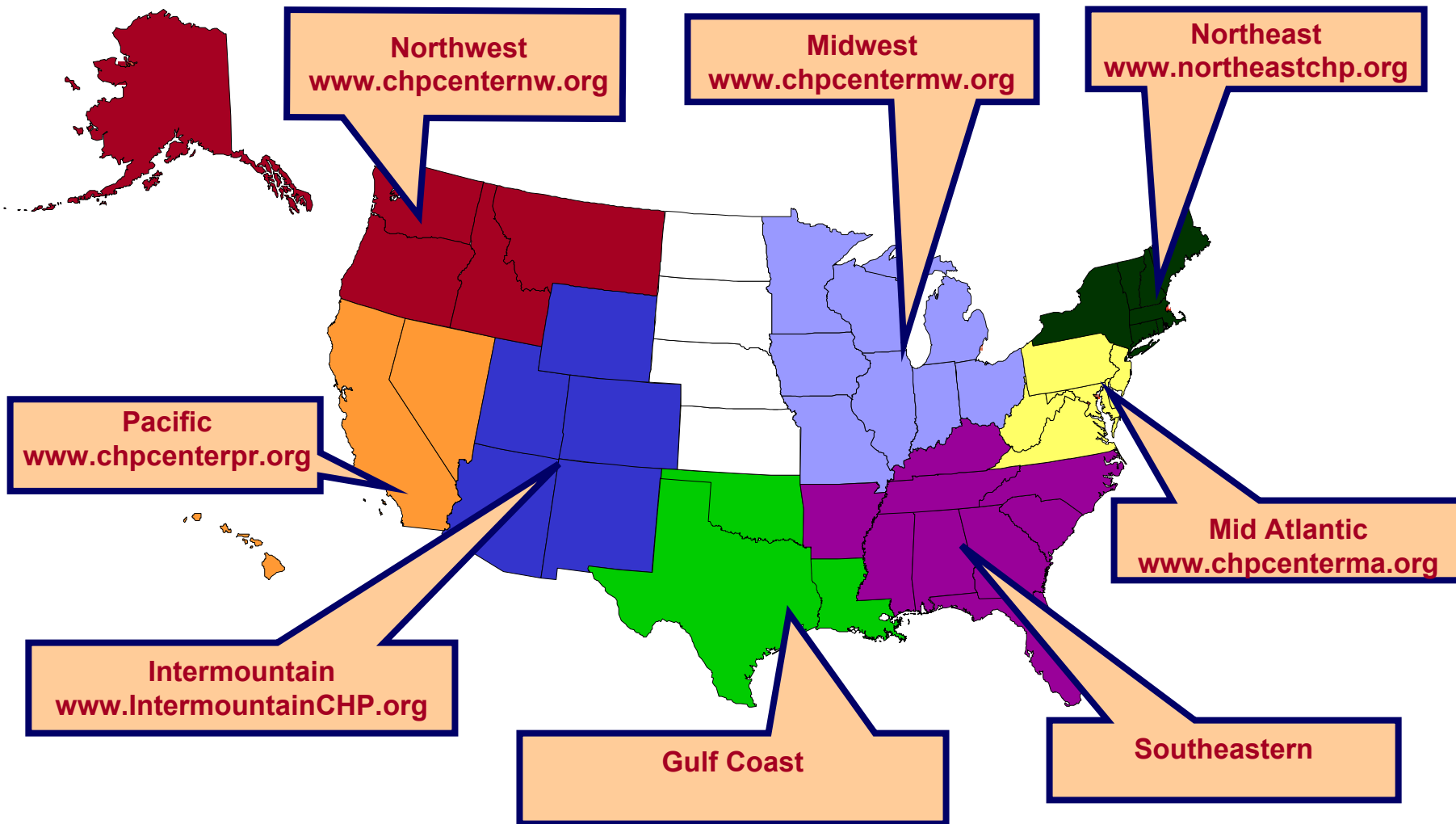
# Website and Publications

- *Market Potential for Advanced Thermally Activated BCHP in Five National Account Sectors*, Energy and Environmental Analysis, Inc. , May 2003
- *Gas-Fired Distributed Energy Resource Technology Characterizations*, NREL, GRI, EEA, Antares, Princeton Energy Resources International , October 2003
- *Cooling, Heating, and Power for Buildings Instructional Module*, Mississippi State University, Mississippi Valley Gas Company, ORNL, January 2004
- *Sector Profiles of Significant Large CHP Markets*, EEA, March 2004
- *Combined Heat and Power Market Potential for Opportunity Fuels*, Draft Report, Resource Dynamics, April 2004
- *Assessment of Large Combined Heat and Power Market*, EEA, April 2004
- *Assessing the Benefits of On-Site Combined Heat and Power during the August 14, 2003 Blackout* , EEA, ORNL, April 2004
- *Clean DG Performance Cost and Analysis*, DE Solutions, April 2004
- *Combined Heat and Power in the Pacific Northwest: Market Assessment*, EEA, July 2004
- *CHP Guide for Boiler Owners and Operators*, ORNL, September 2004
- *Database of USCHPA Installations Incorporating Thermal Energy Storage TES and/or Turbine Inlet Cooling (TIC)*, Cool Solutions Company, September 2004



# Regional Application Centers

The regional application centers will promote combined heating and power (CHP) technology and practices, serve as a central repository and clearinghouse of CHP information, and identify and help implement regional CHP projects.



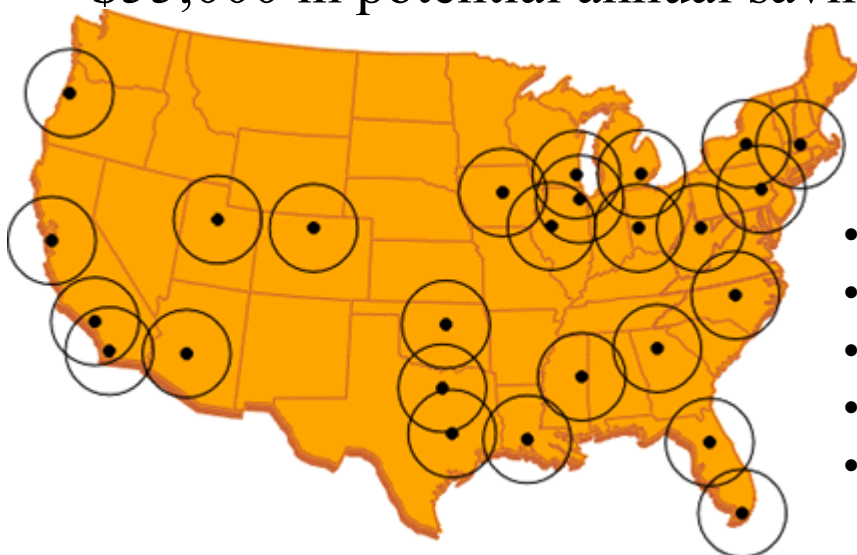




# Industrial Assessment Centers

- Strengthen interface between IAC and RAC – increase small industrial market
- Training on CHP for IACs
- Incorporate CHP into IAC assessment recommendations where appropriate, conversely encourage RACs to recommend IAC assessments where appropriate
- Introduce engineering students to CHP – broaden the workforce

The IAC program enables small/medium-sized manufacturers to have comprehensive energy, waste and productivity assessments performed at no cost. Recommendations from these assessments have averaged \$55,000 in potential annual savings for each manufacturer.



- Within Standard Industrial Codes (SIC) 20-39.
- Gross annual sales below \$100 million.
- Fewer than 500 employees at the plant site.
- Annual energy bills from \$100,000 to \$2 million.
- No professional in-house staff to perform assessment.

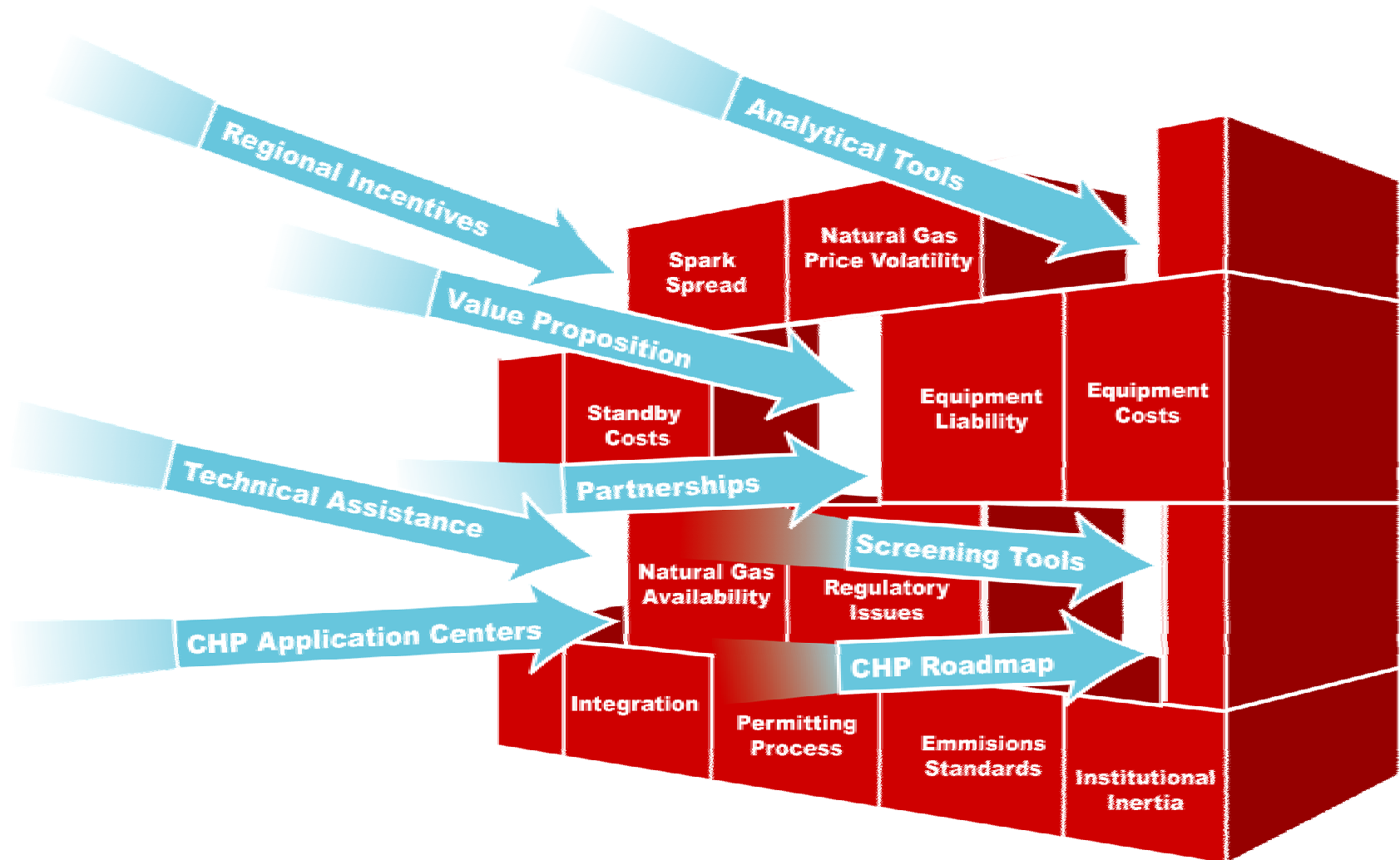


# Coming Soon

- Develop Efficiency Calculation Standards for CHP systems. These standard calculations are specifically designed for comparison between CHP systems developed under the DOE program (Efficiency is a major milestone and consistent calculation methodology is needed)
- Tool Kit CD – Compilation of all CHP tools, data, market information, etc.
- Targeted Outreach – in conjunction with USCHPA and others, supply information on CHP to facilities identified as being technical and economically feasible sites
- DOE Case Studies and Case Study Data Base
- Link all CHP State Databases with a common interface (Regulatory, Utility, Emissions, etc.)

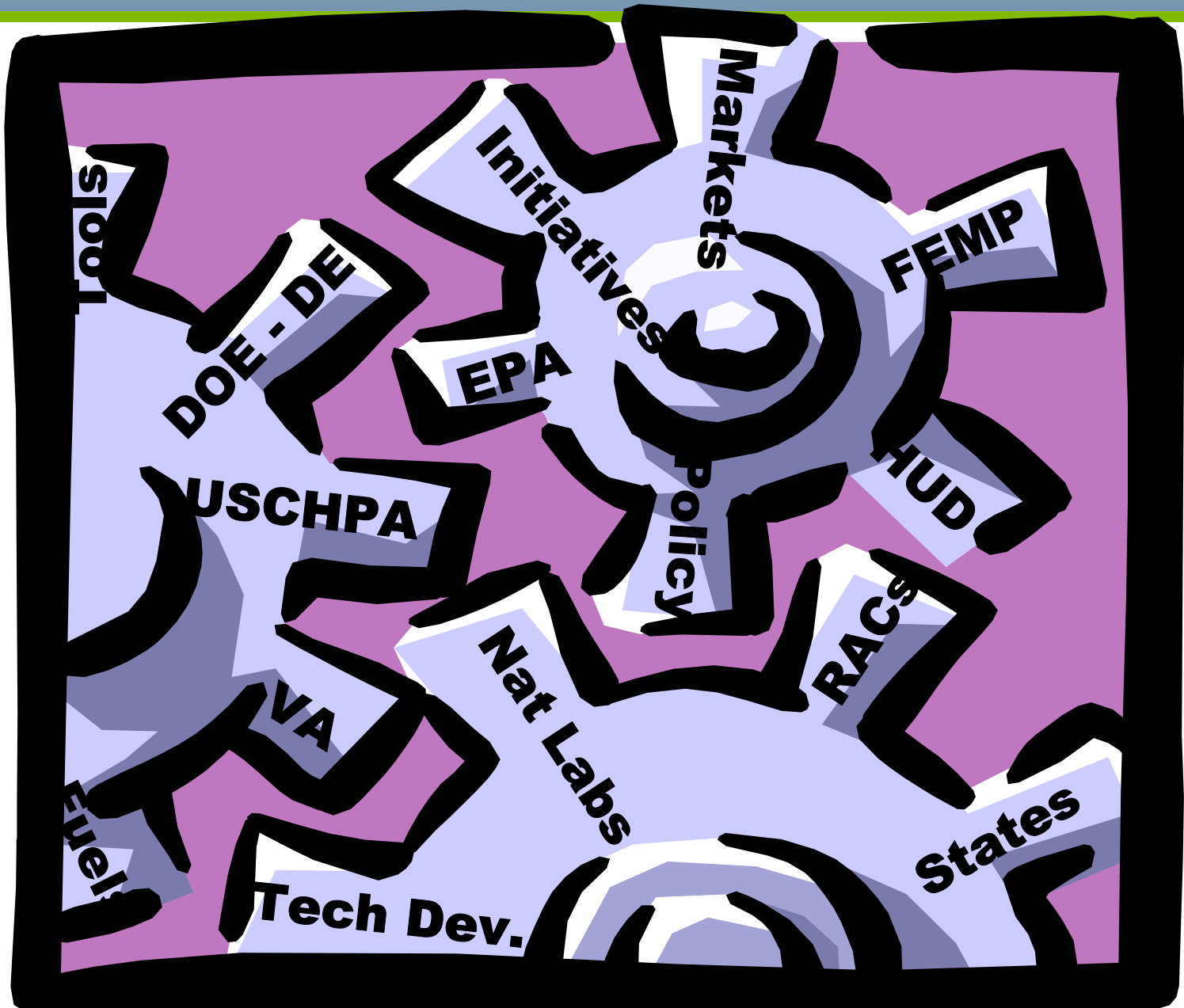


# Barriers and Risks Can be Mitigated by Implementing Program Strategies





# Team Work for Success





U.S. Department of Energy  
Energy Efficiency and Renewable Energy

# Contact Information

Merrill Smith

202-586-3546

Merrill.Smith@ee.doe.gov

**[www.eere.energy.gov/de](http://www.eere.energy.gov/de)**



# Discussion

With our limited budget, and our current activities – what direction would you like to see the government programs take or what activities do you think we still need to undertake in the future?